Characterizing the Hydrogeology of the Hyporheic Zone along the 300 Area of the Hanford Site, Washington

Rob D. Mackley and Brad G. Fritz

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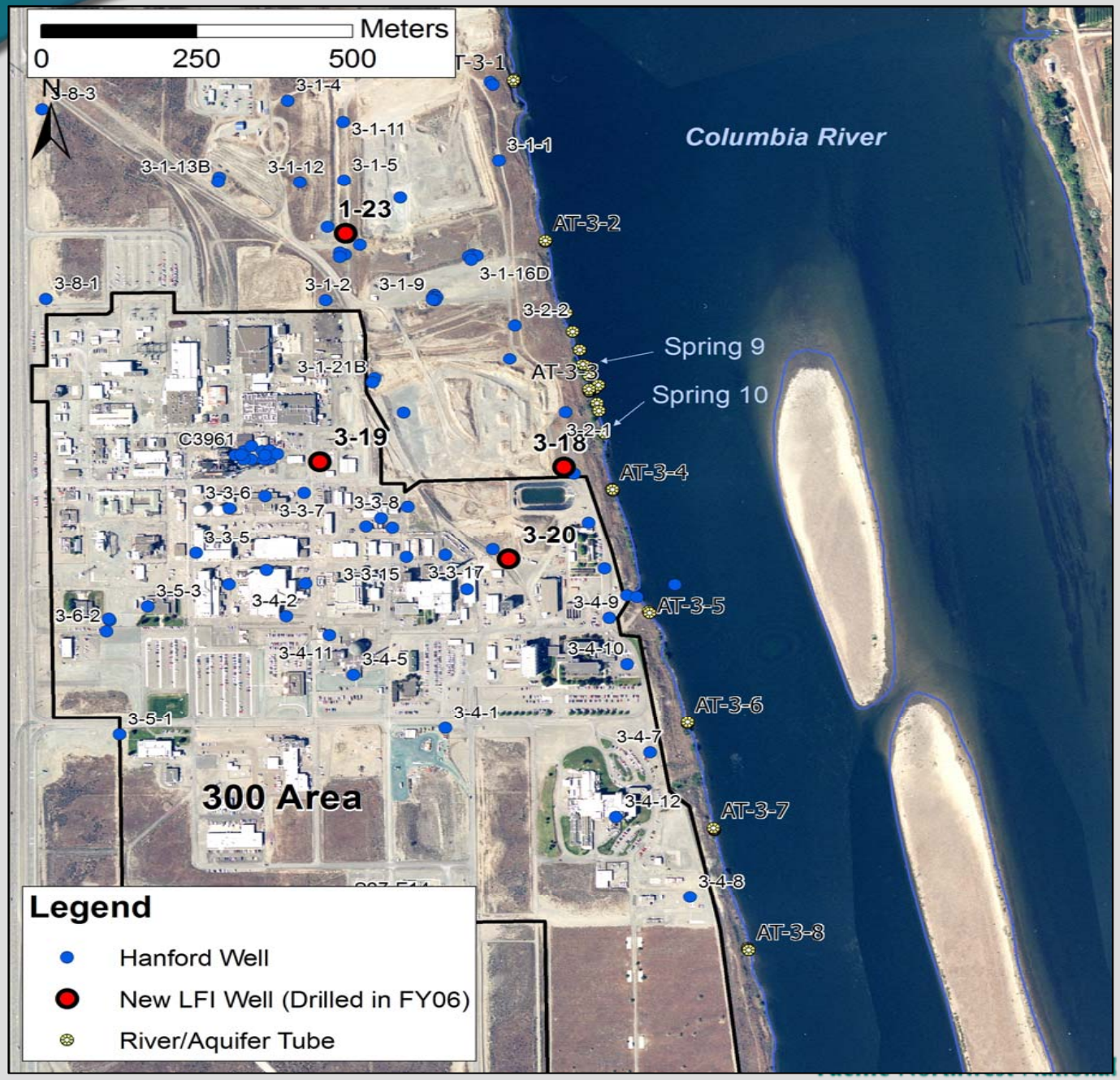
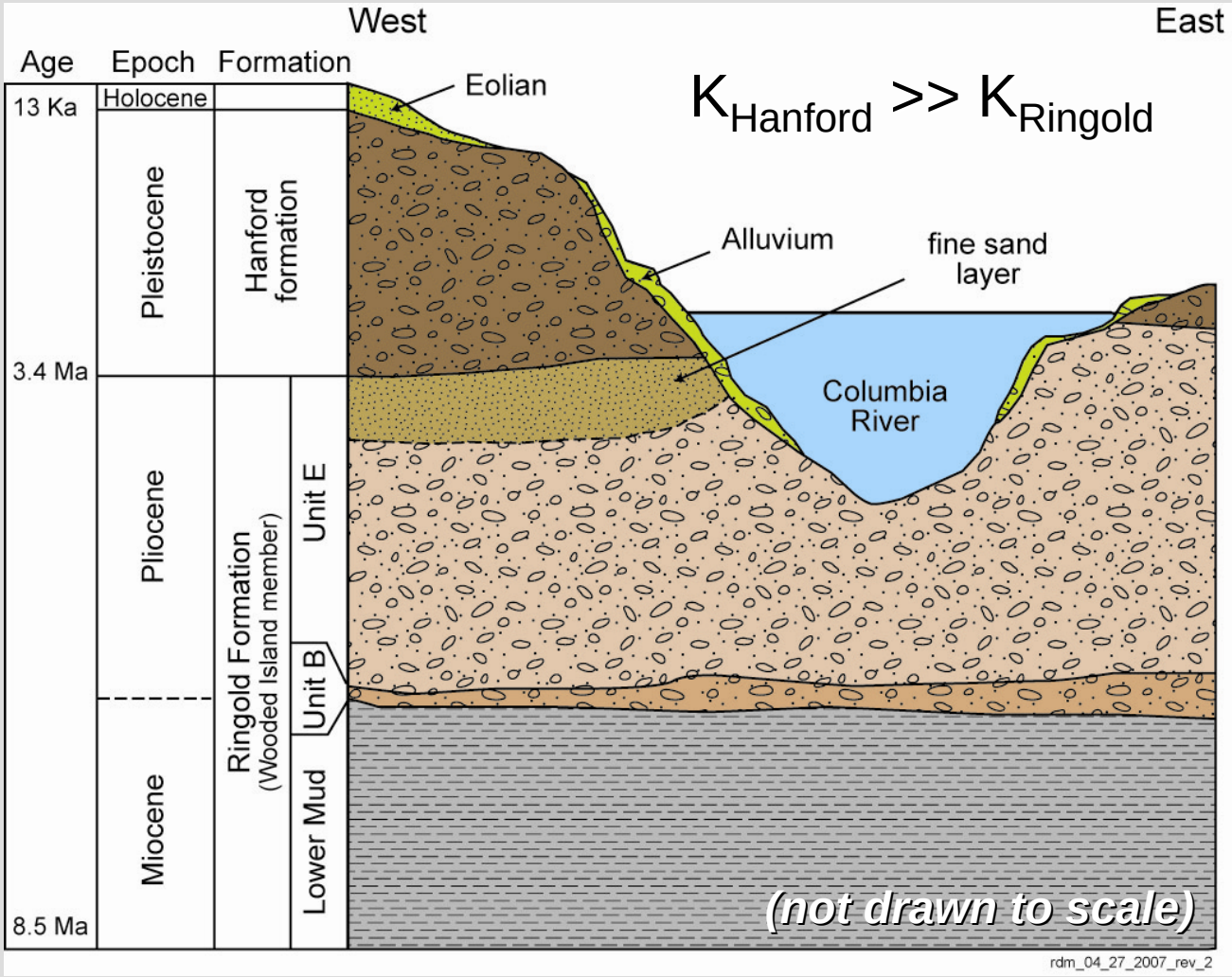
Outline

- Study Setting
  - 300 Area Hanford Site
  - Hydrostratigraphic Units
- Needs and Objectives
  - Characterize Ringold Fm. confining layer
- Study Approach
  - Characterize, map, and correlate confining layer
  - Estimate *contributing shoreline area* in channel
- Study Outcomes and Conclusions


Meters
0
250
500
N
Columbia River
3-8-3
3-1-4
3-1-11
3-1-1
3-1-13B
3-1-12
3-1-5
1-23
AT-3-2
3-1-16D
3-8-1
3-1-2
3-1-9
3-2-2
Spring 9
3-1-21B
AT-3-3
Spring 10
3-2-1
C3961
3-19
3-18
AT-3-4
3-3-6
3-3-7
3-3-8
3-20
3-3-5
3-3-15
3-3-17
3-5-3
3-4-2
3-4-9
AT-3-5
3-6-2
3-4-11
3-4-5
3-4-10
AT-3-6
3-5-1
3-4-1
3-4-7
300 Area
3-4-12
AT-3-7
3-4-8
AT-3-8
Legend
Hanford Well
New LFI Well (Drilled in FY06)
River/Aquifer Tube

Hydrostratigraphic Units

(Spring 9 and 10)



Motivation

- Problems
  - Confining layer controls vertical and horizontal distribution of uranium contamination
  - Geologic picks are based upon boreholes from wells located 100's of meters away

Objective

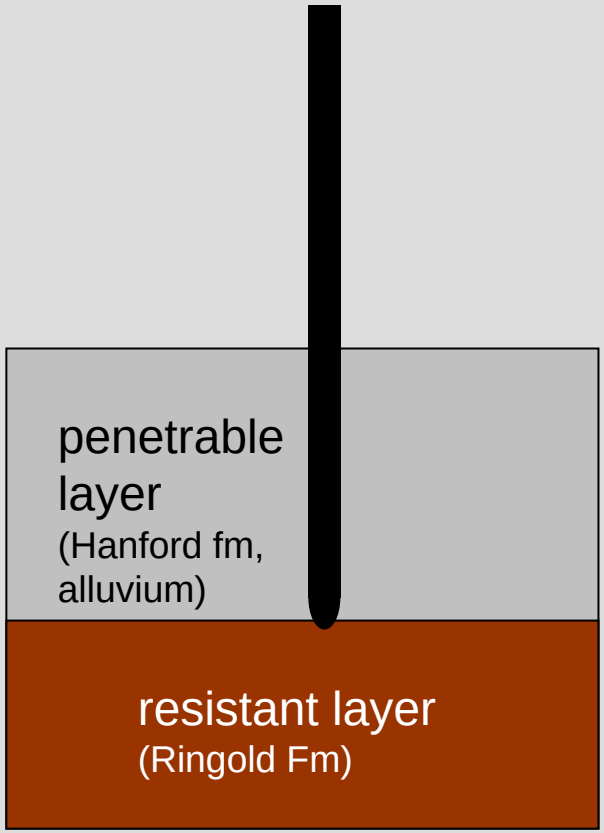
- Characterize, map, and correlate hydrogeology within hyporheic zone
  - Focus efforts to defining top of Ringold contact (confining layer)

Approach

(≠ traditional borehole geology methods)

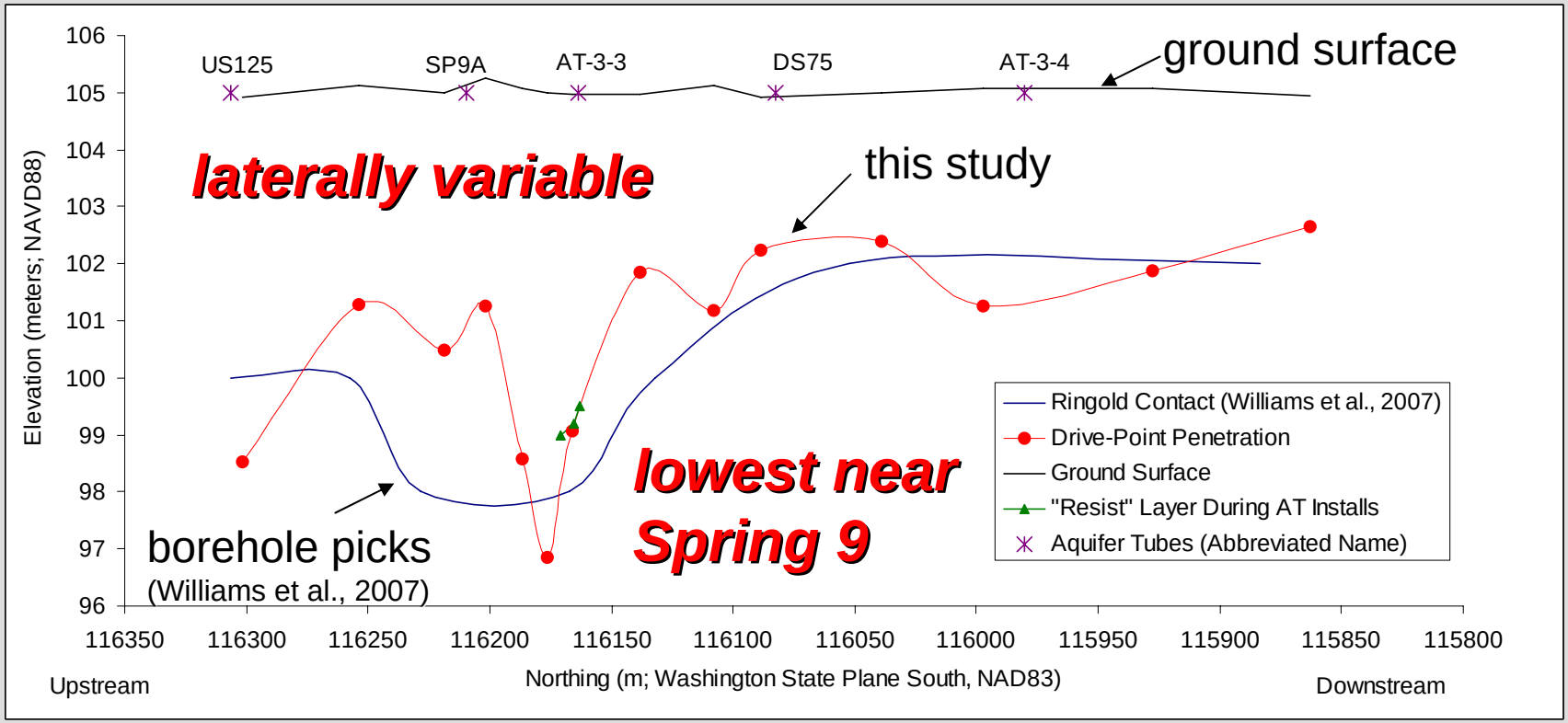
- drive-point penetration
- underwater video
- bathymetry
- sub-bottom profiling
- sediment sampling

Drive-Point Penetration Testing (DPT)

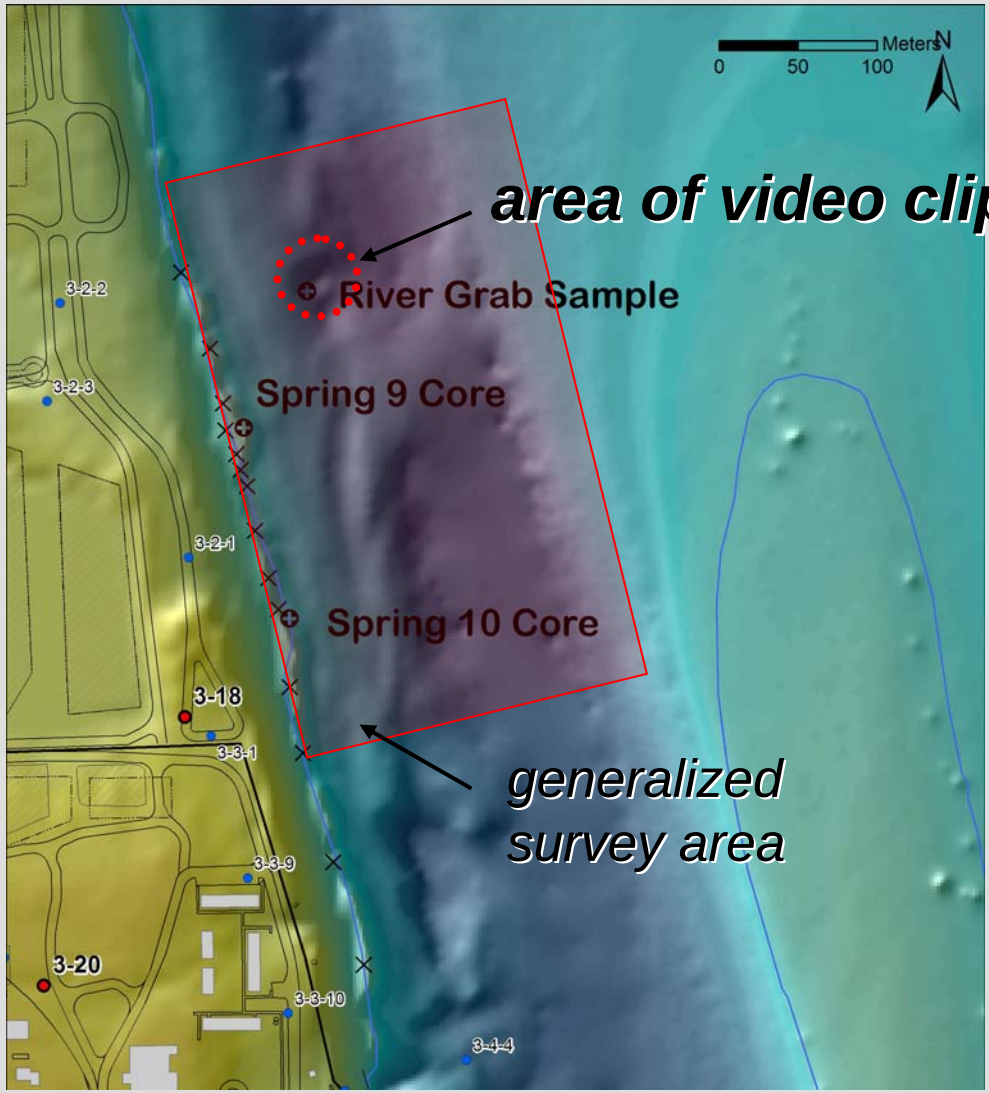


- 1” diameter drive rod with rounded tip
- advanced until refusal
- Multiple points along shoreline
- Validate with lithology info from cores and well logs

DPT Results


106
105
104
103
102
101
100
99
98
97
96
Elevation (meters; NAVD88)
US125
SP9A
AT-3-3
DS75
AT-3-4
ground surface
laterally variable
this study
lowest near Spring 9
borehole picks
(Williams et al., 2007)
Ringold Contact (Williams et al., 2007)
Drive-Point Penetration
Ground Surface
"Resist" Layer During AT Installs
Aquifer Tubes (Abbreviated Name)
116350
116300
116250
116200
116150
116100
116050
116000
115950
115900
115850
115800
Upstream
Northing (m; Washington State Plane South, NAD83)
Downstream

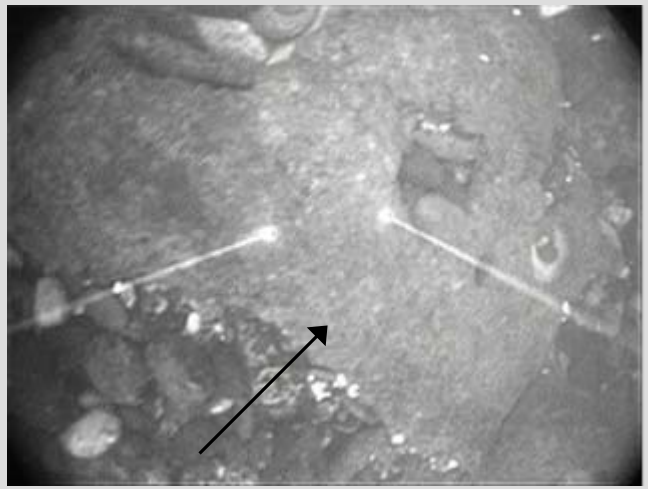
Underwater Video



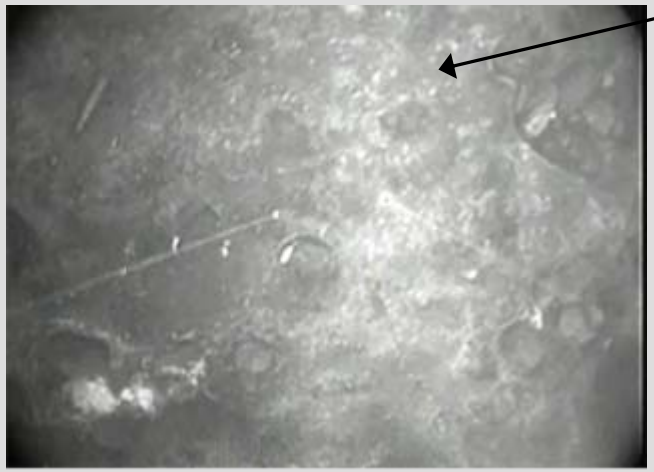
Outcrop Analog For Video Footage
(~5 mi upstream)

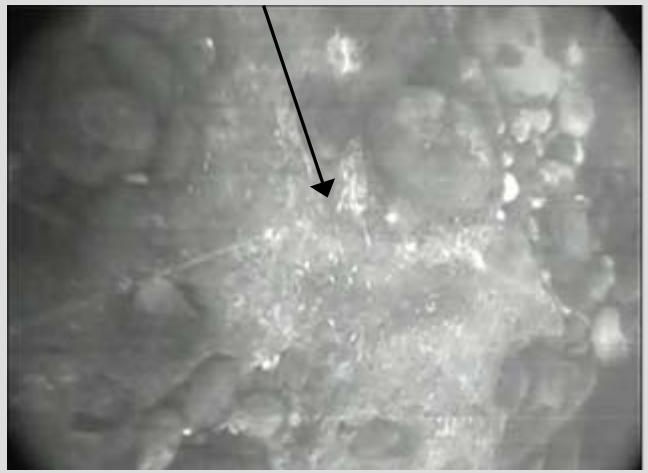
Underwater Video Clip

Underwater Video Screen Shots
(example near Spring 9)

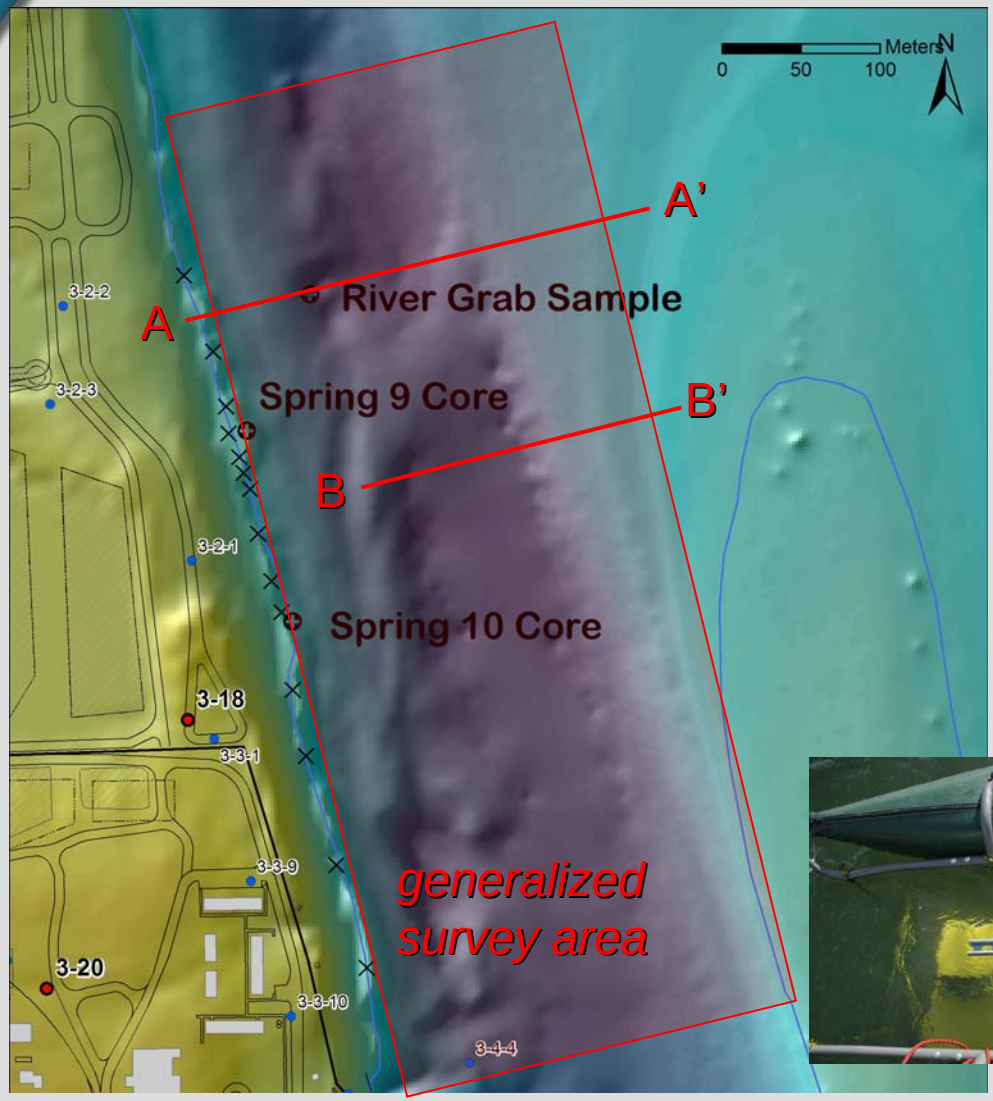


exposures of gravelly to fine sand Ringold Fm (~96-98 m)



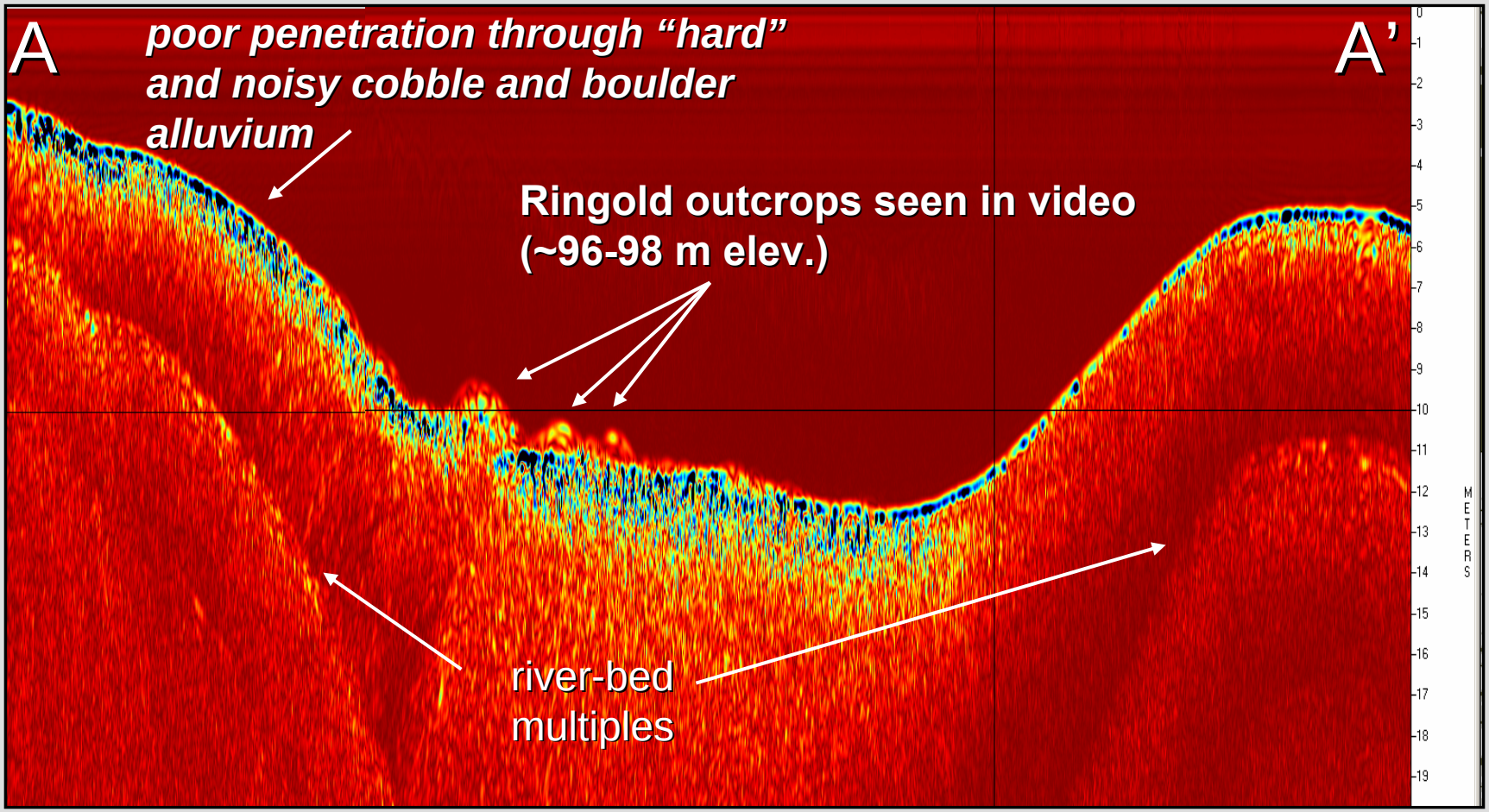


Sub-Bottom (Acoustic) Profiling

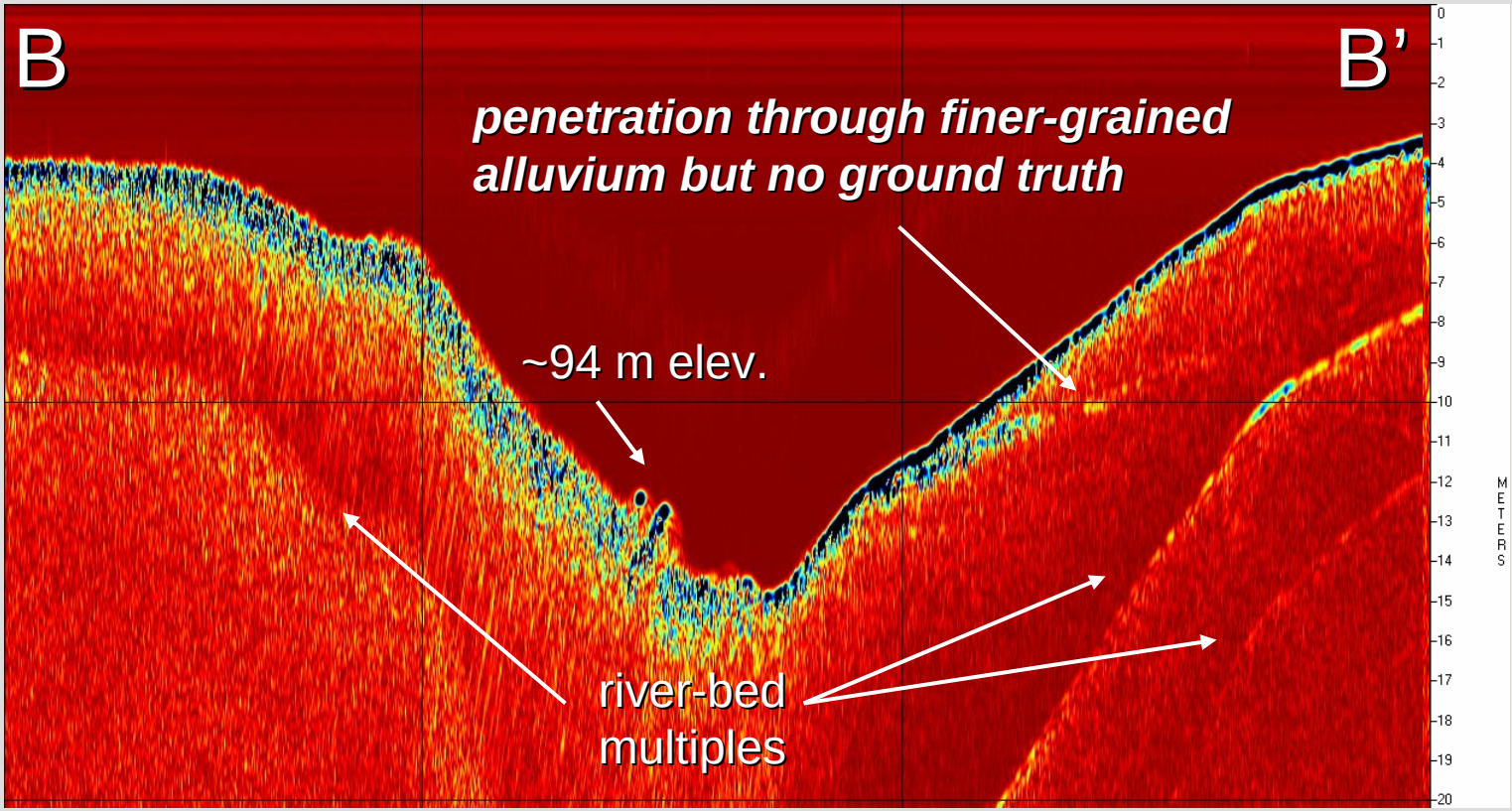


- EdgeTech 216S Towfish
  - 2-10 kHz
  - 20 ms pulse
  - 2-3 knots

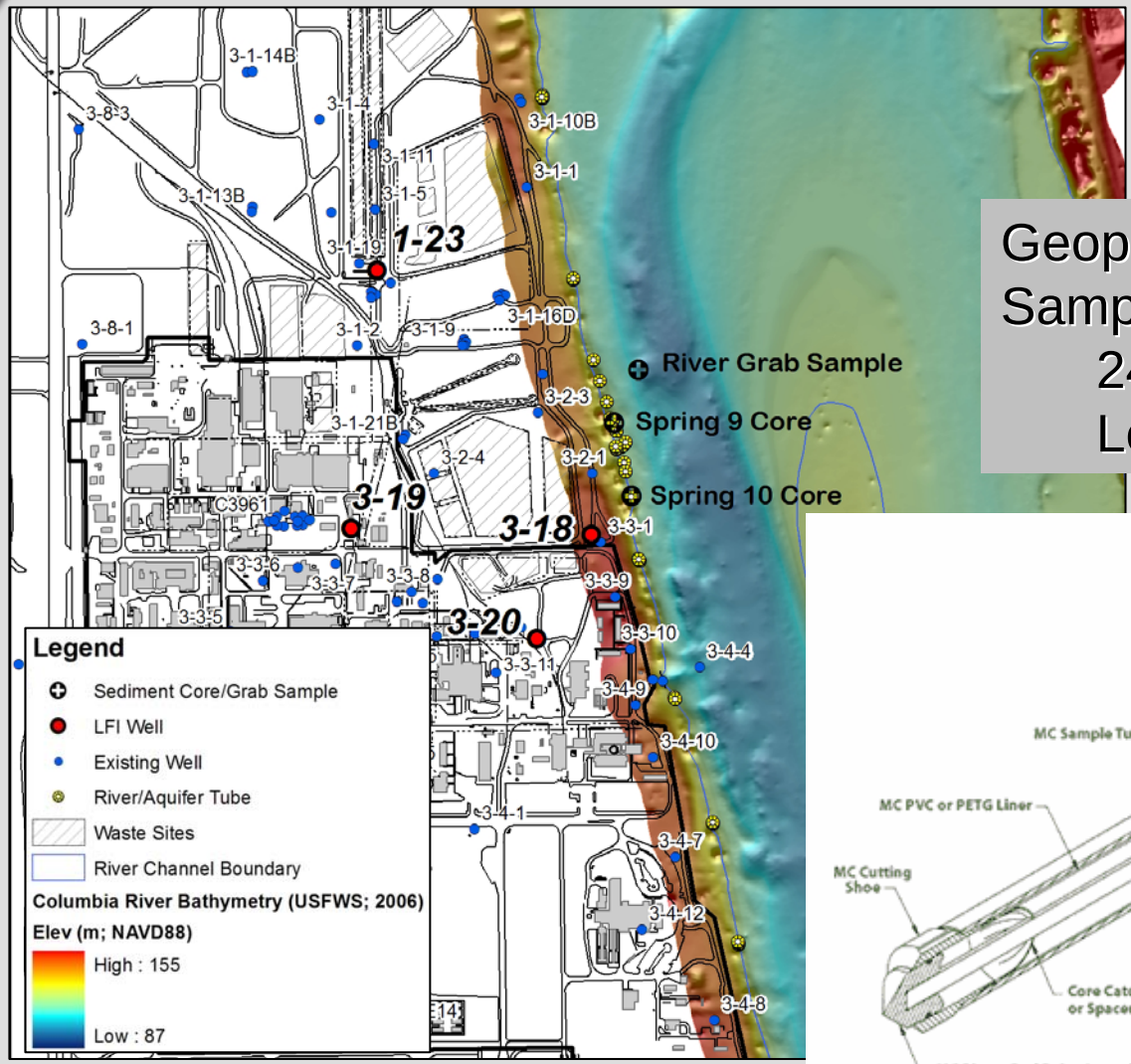
West-East Transect A



West-East Transect B

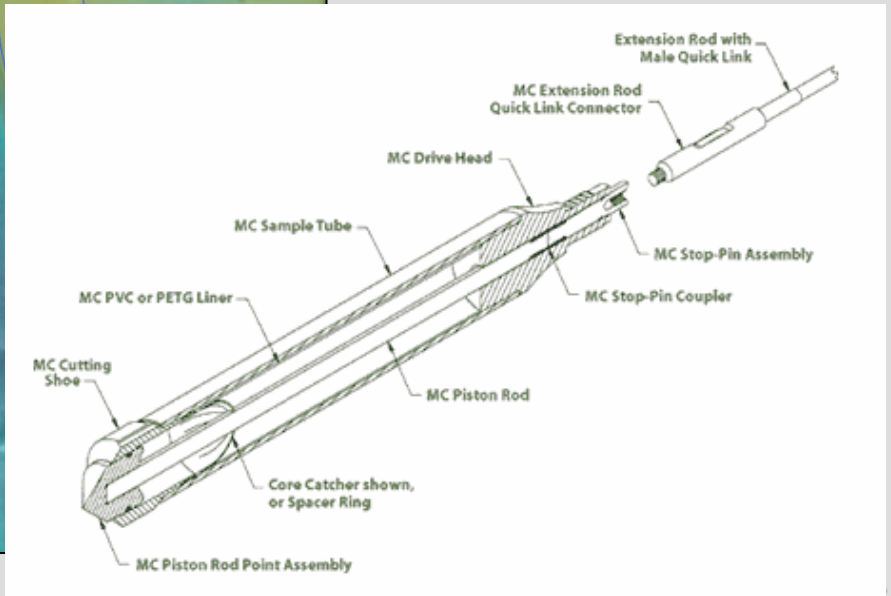


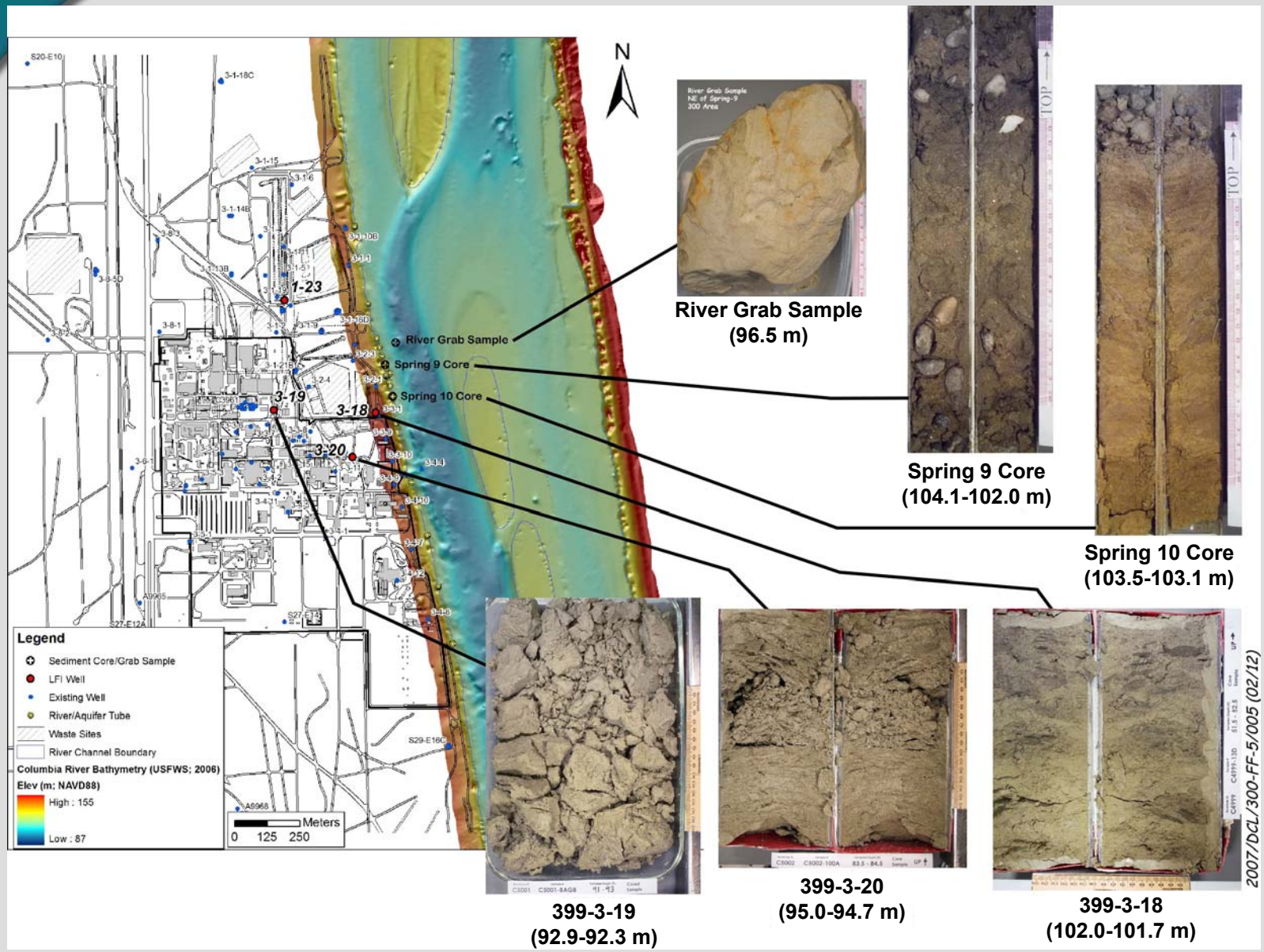
Core and Grab Samples



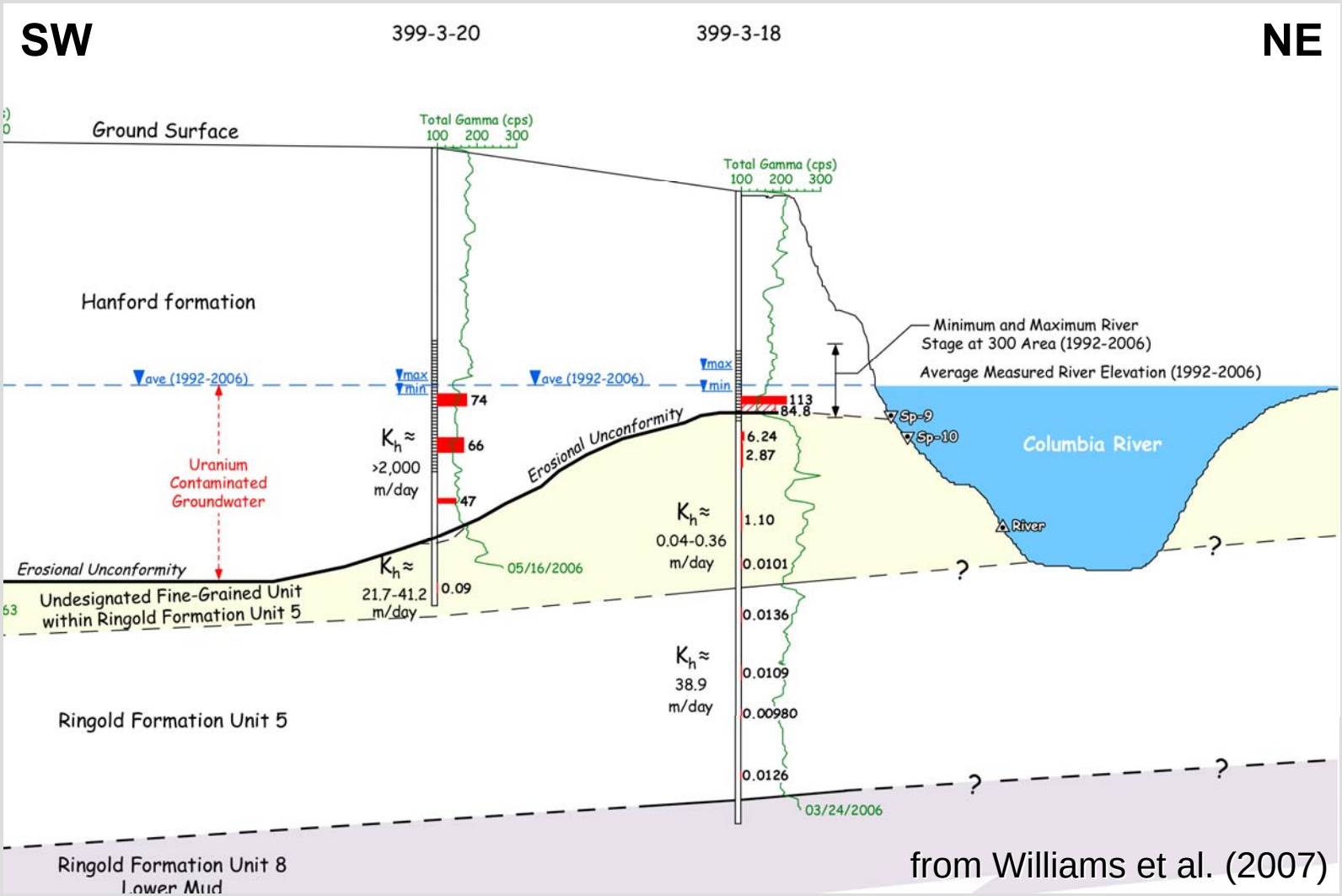
Geoprobe® Macro-Core Sampler

- 24” x 1.5”
- Lexan liner




N
River Grab Sample
Spring 9 Core
Spring 10 Core
1-23
3-19
3-18
3-20
Legend
Sediment Core/Grab Sample
LFI Well
Existing Well
River/Aquifer Tube
Waste Sites
River Channel Boundary
Columbia River Bathymetry (USFWS; 2006)
Elev (m; NAVD88)
High : 155
Low : 87
Meters
0 125 250
River Grab Sample
(96.5 m)
Spring 9 Core
(104.1-102.0 m)
Spring 10 Core
(103.5-103.1 m)
399-3-19
(92.9-92.3 m)
399-3-20
(95.0-94.7 m)
399-3-18
(102.0-101.7 m)
2007/DCL/300-FF-5/005 (02/12)

Research Outcome



from Williams et al. (2007)

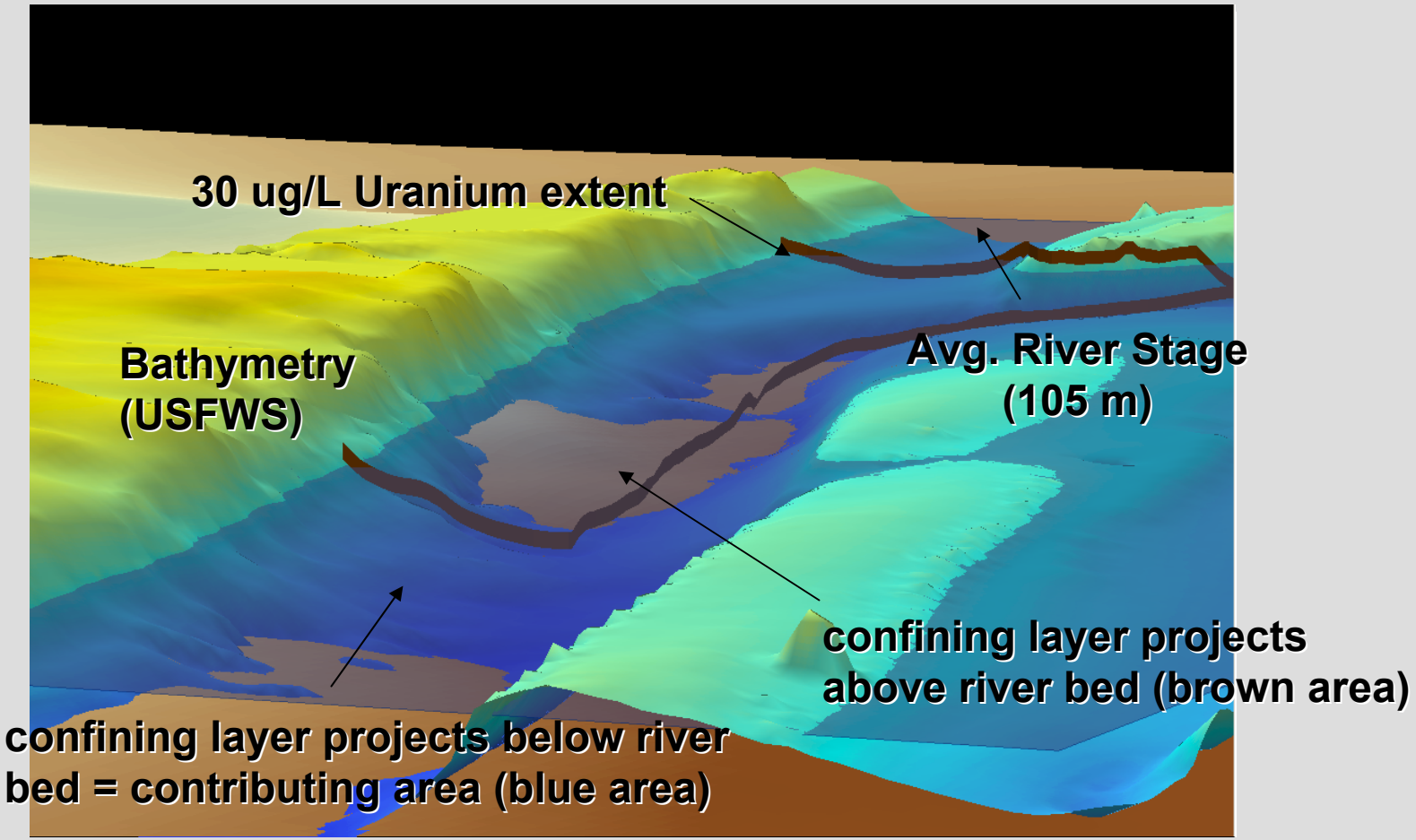
Contaminant Contributing Area

Area of the river shoreline that is:

1) Between the avg river stage elevation and the deepest point in channel (thalweg)
2) Where the confining layer (Ringold Fm) projects below the river bed
3) Within the 30 ug/L uranium extent

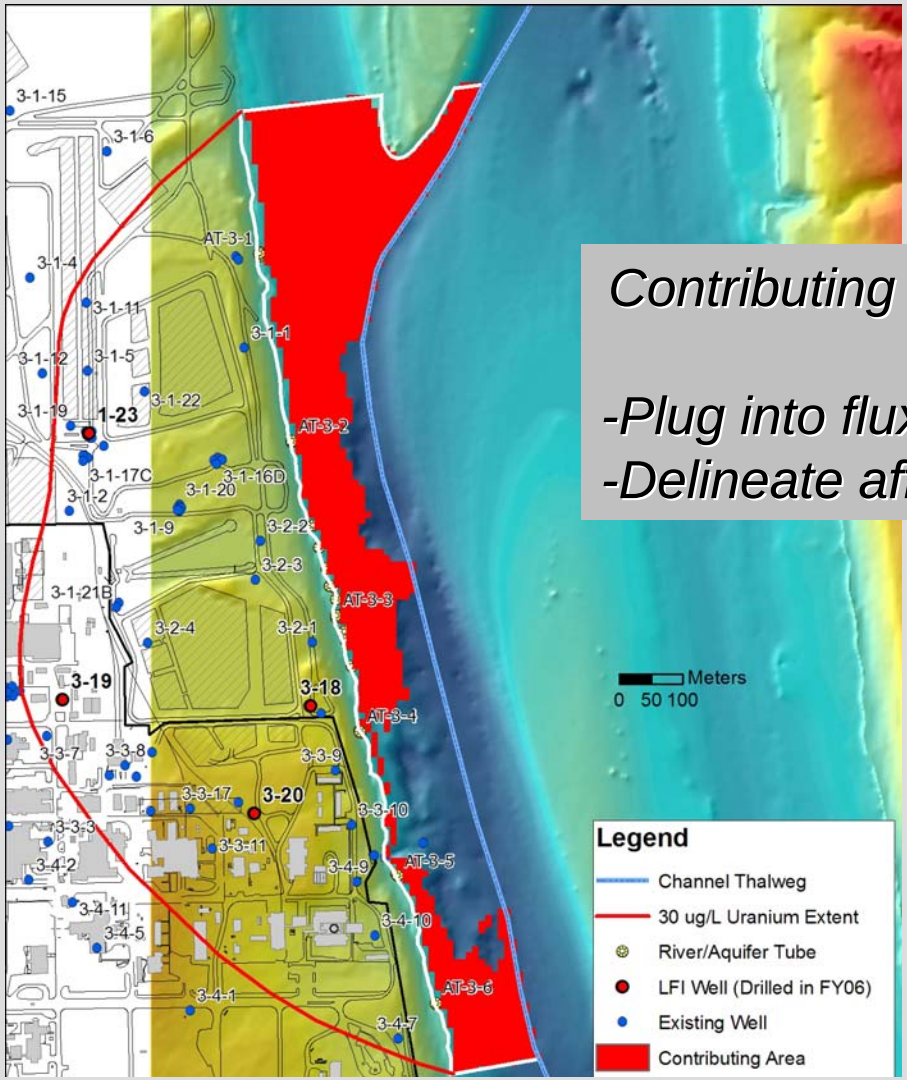
Interface for water/contaminant flux

Estimating Contributing Area
(based on large-scale geology model)



(view looking upstream to the northwest)

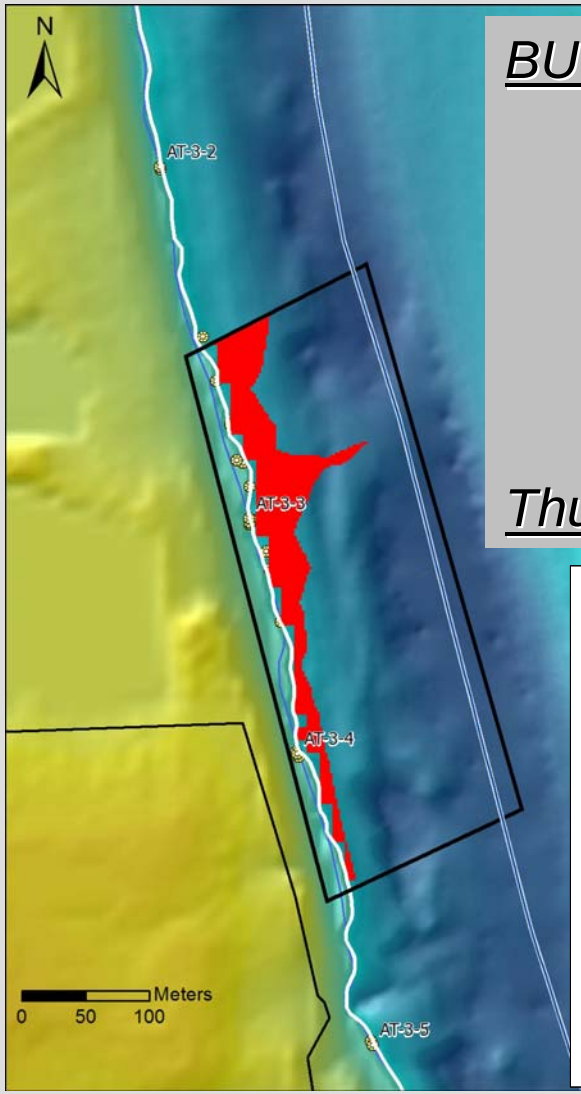
Estimating Contributing Area
(based on large-scale geology model)



Contributing Area = 170,000 m²

-Plug into flux calc.'s
-Delineate affected area

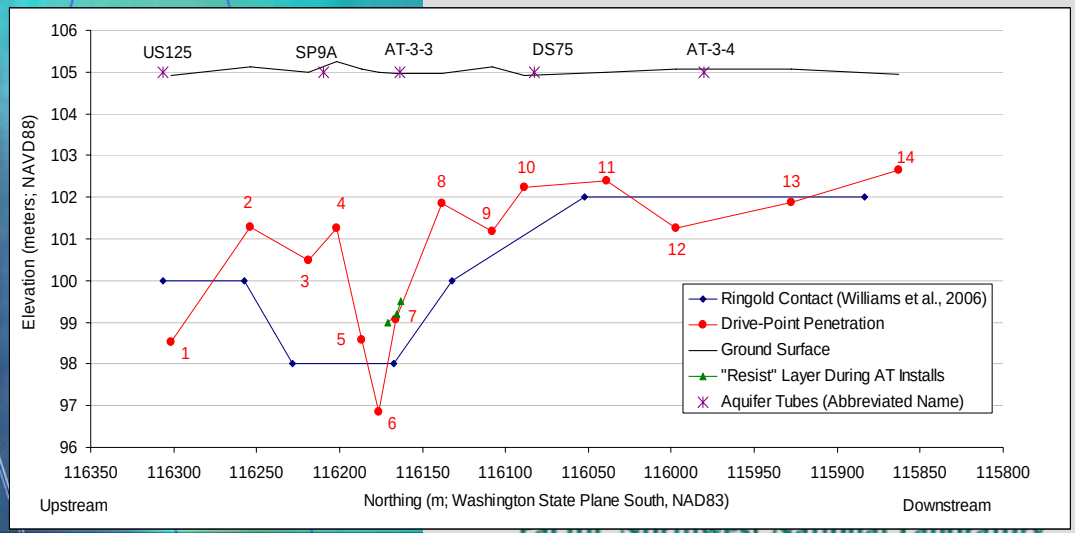
Estimating Contributing Area
(based on data in this study



BUT if incorporate new finer-detailed Ringold contact information from this study (between Springs 9 &10)

Ringold Contact appears to be higher based on data from this study

Thus contributing area is ~3x's lower



Conclusions

- Top of Ringold varies by several meters along shoreline
  - lowest near Spring 9
  - controls contributing area estimates
- New data extends the geologic model beyond inland wells directly into Columbia River channel
  - more accurate estimates of affected shoreline area
- Non-conventional investigation methods help augment traditional borehole geologic methods

Future Efforts

- More coring and potentially more DPT (validation)
- Extend finer-detail hyporheic zone hydrogeology up/down shoreline
- Integrate finer-scale geologic data from this study into larger-scale geologic model

Acknowledgements

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